Measurement and Evaluation of Vibration Produced by Landing Craft Air Cushioned (LCAC) and

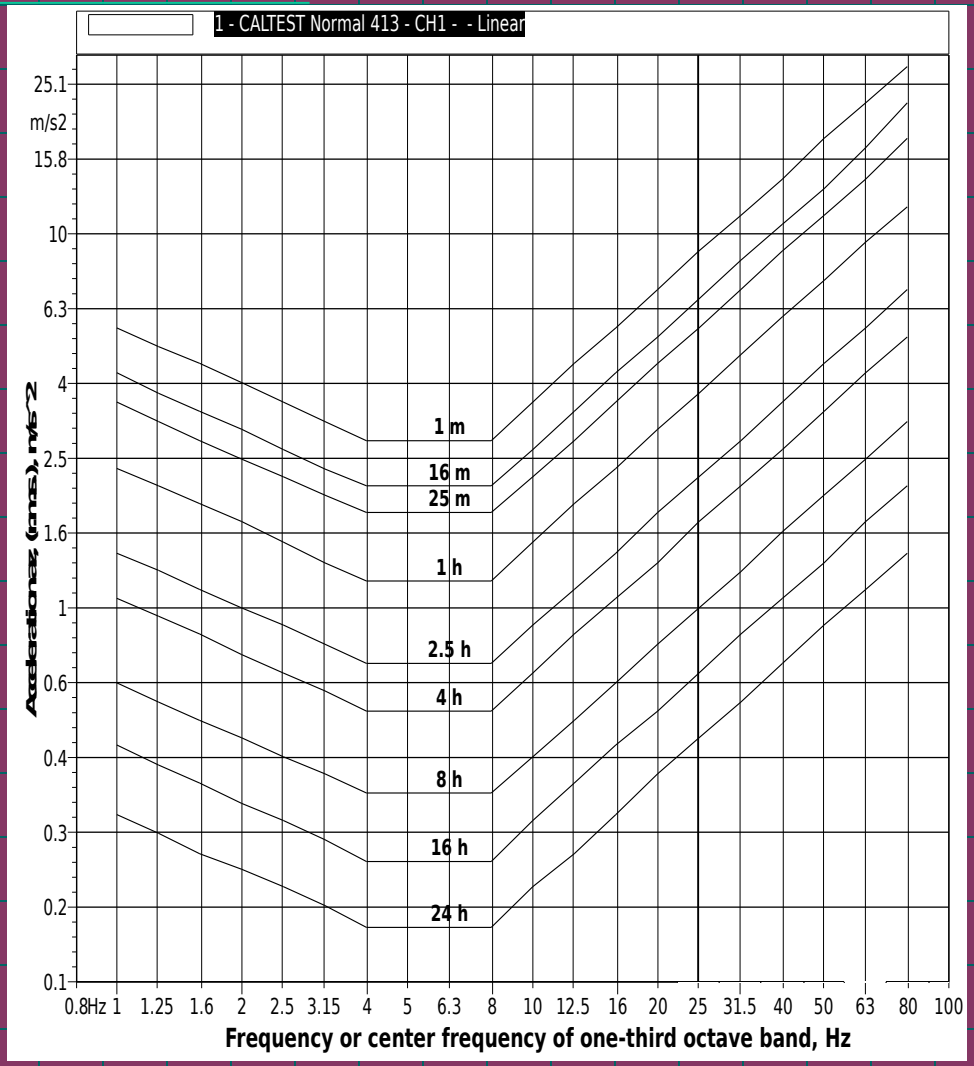
Reason for WBV Studies

- Inadequate data exists regarding the overall effectiveness of the LCAC & Navy Helicopter seating systems with respect to WBV exposures.

Objectives of the Studies

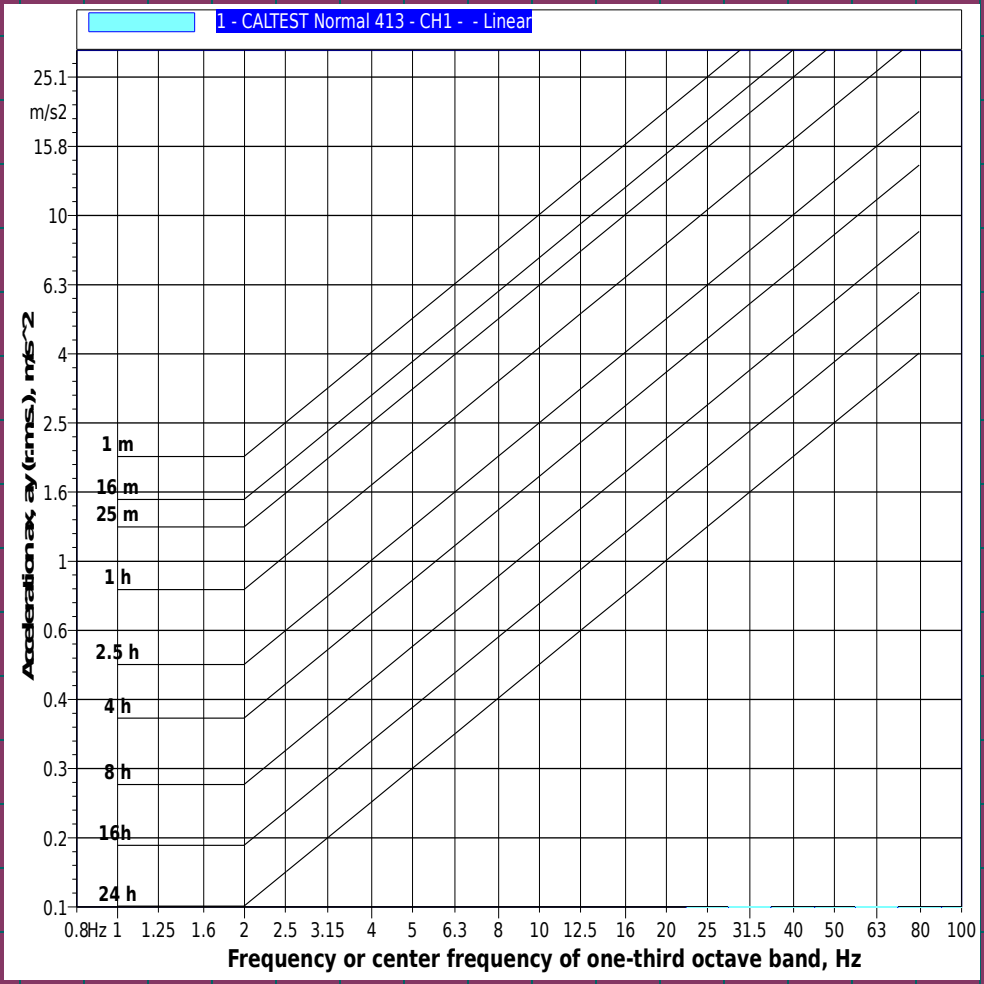
- Determine the WBV vibration produced from the LCAC & MH-60S seating systems
- Conduct a vibration frequency analysis of the respective seating systems
- Determine WBV exposures for LCAC & MH-60S personnel
- Statistically analyze vibration acceleration values to determine if a significant difference exists between types of seating systems
- Determine the effectiveness of the seats at attenuating vertical vibration by calculating a Seat Effective Amplitude Transmissibility (SEAT) value

WBV Standards



- ACGIH-TLV
- ISO 2631-1
- MIL-STD 1472-E

WBV Standards (Cont'd)



- X,Y ACGIH TLV Curves

WBV Equipment

- Larson Davis HVM 100
- PCB Triaxial Seat pad Accelerometer
- Sony PC204 Digital Data Recorder

WBV Equipment

- Transmissibility Study
- Signal Conditioner
- Single Axis Accelerometers

WBV Equipment

- Larson Davis Frequency Analyzer
- Analysis software
- Calibration Unit

LCAC

- 6 seated naval operators
- 2 Liftmaster seats
- 4 Navigator type seats
- Amphibious vehicle
- Carries primarily vehicle loads, equipment and troops

MH-60S

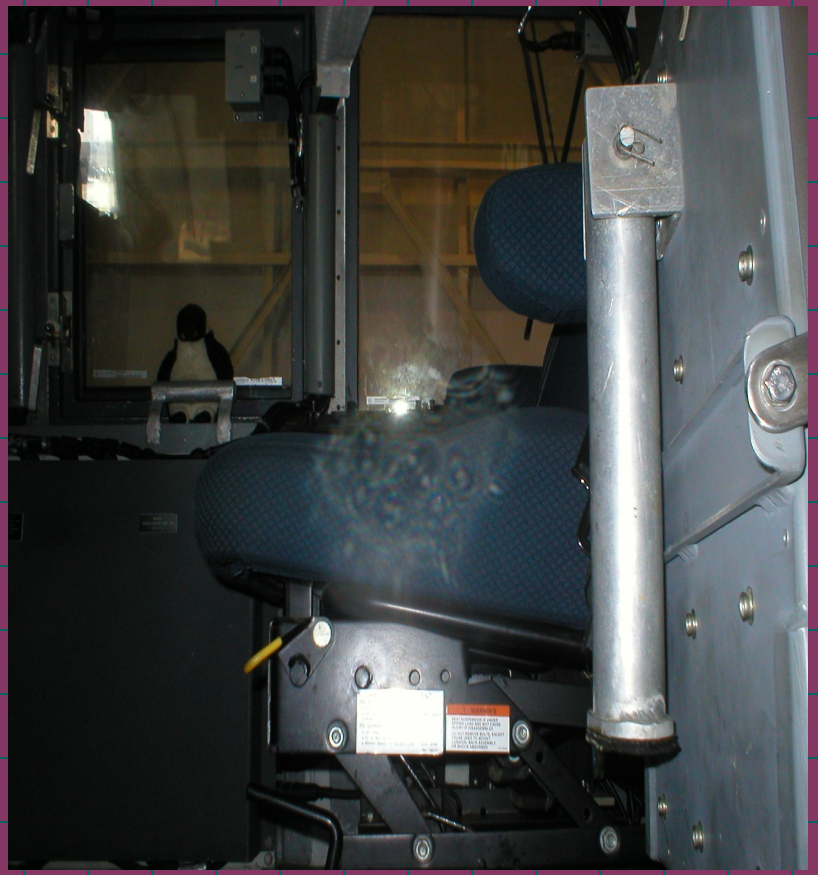
- 2 Navy Pilots
- Up to 13 crewmembers
- SAR, VERTREP, Spec Warfare Support, & Mine Countermeasures

LCAC Liftmaster Seat

- Simple design
- Port and Starboard Cabins
- Operator monitors LCAC load
- Restraint system
- Non- adjustable

LCAC Navigation Seat

- Armrests
- Suspension system
- Active restraints
- Molded seat pans
- Adjustable back

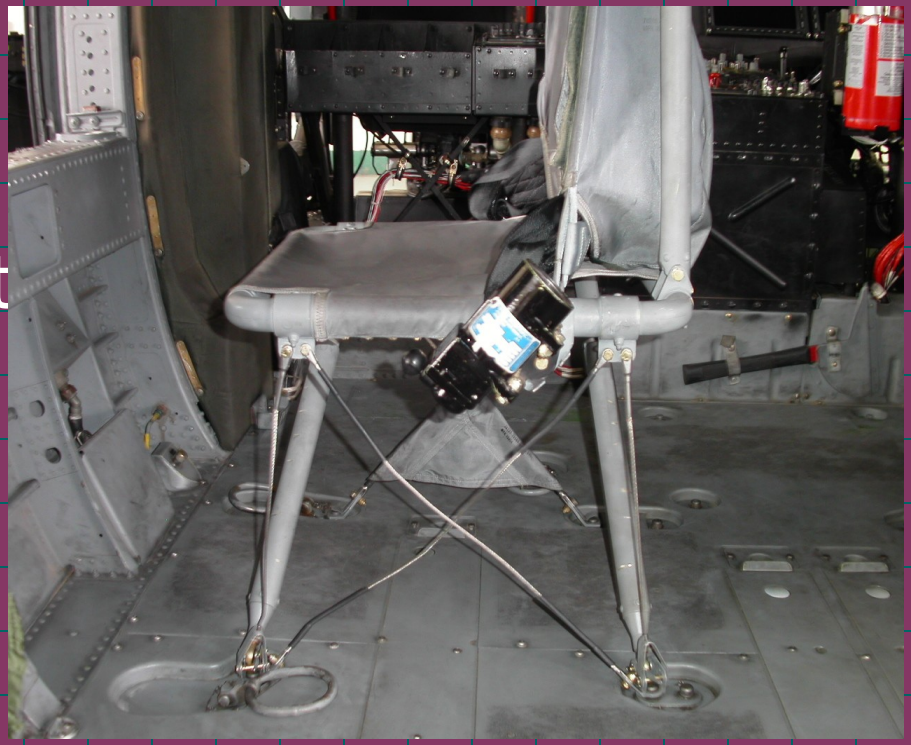


MH-60S Pilot/Copilot Seat

- 1” Foam Cushion
- Minimal lumbar support
- Adjustable Fore/aft & vertically
- Crash resistant

MH-60S Crew Seat

- Simple Design
- No Cushion
- Canvas Mesh Seat
- No lumbar support



Methodology

- LCAC Operational Factors
  - Wind direction 4-13 k
  - Air temperatures 52-66 degrees F
  - Wave direction/height west/southwest 3-5 ft
  - Wave period 9-14 seconds
  - Speed 30-35 knots
- MH-60S Operational Factors
  - In Flight
  - Constant RPM (258)
  - Speed 100-125 knots

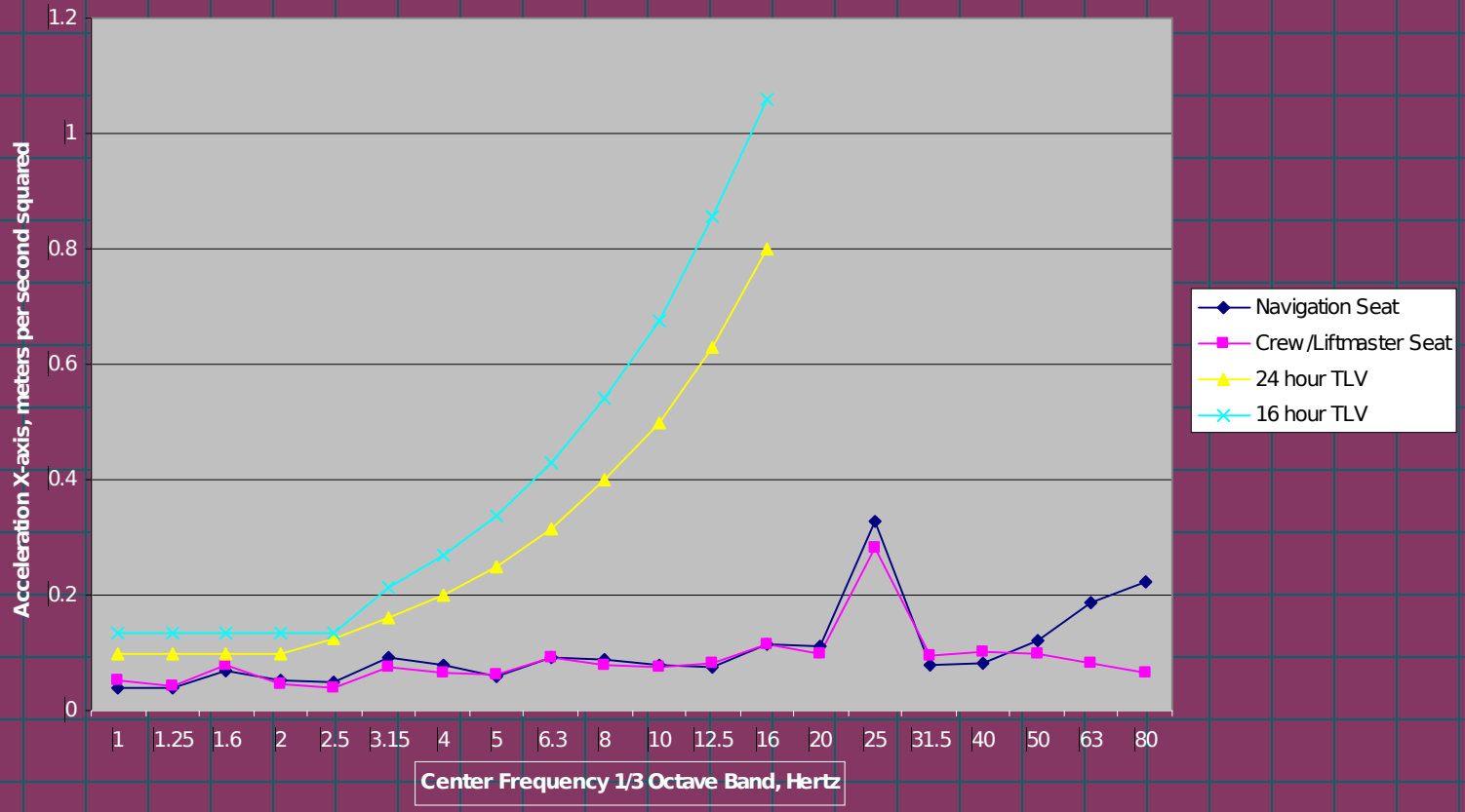
Limitations of the Studies

- Sample size
- Duration of measurements

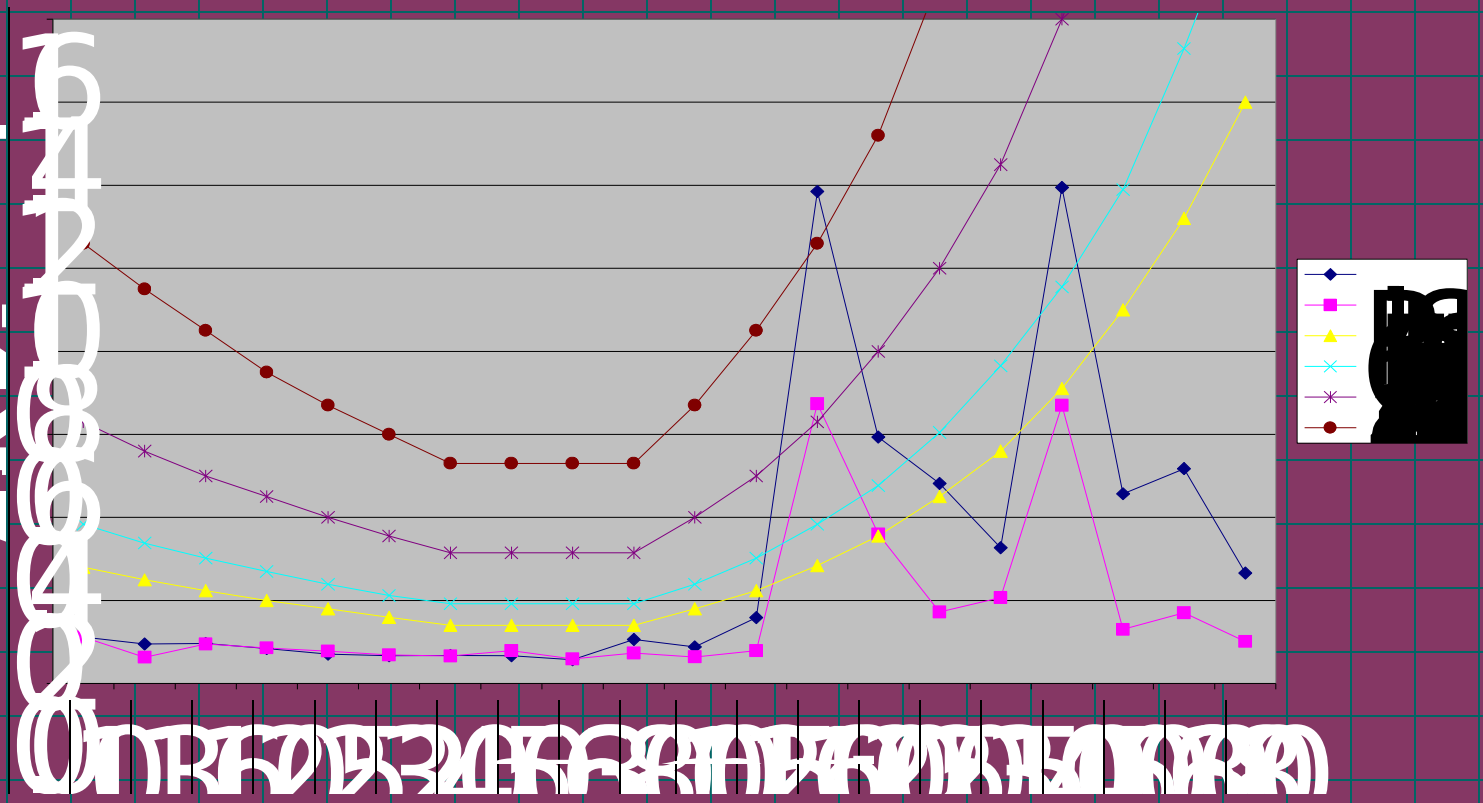
Sampling Strategy

- X-Axis, Y-Axis Each Seat 30
- Z-Axis Each Seat 60
- Transmissibility Seat 30
- Transmissibility Floor 30
- Each Study analyzed >300 individual 108 sec samples

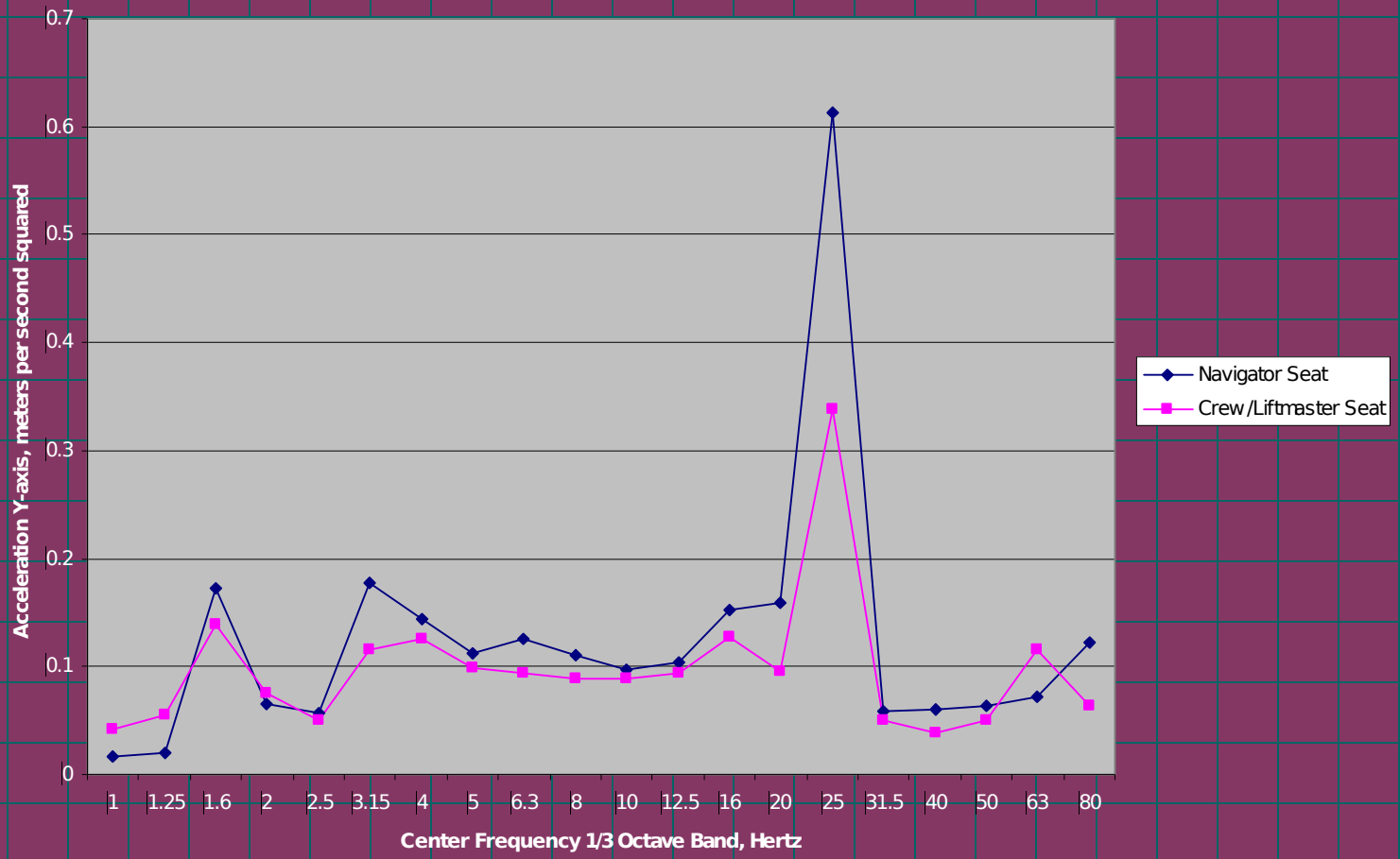
LCAC X-axis Mean Acceleration Values



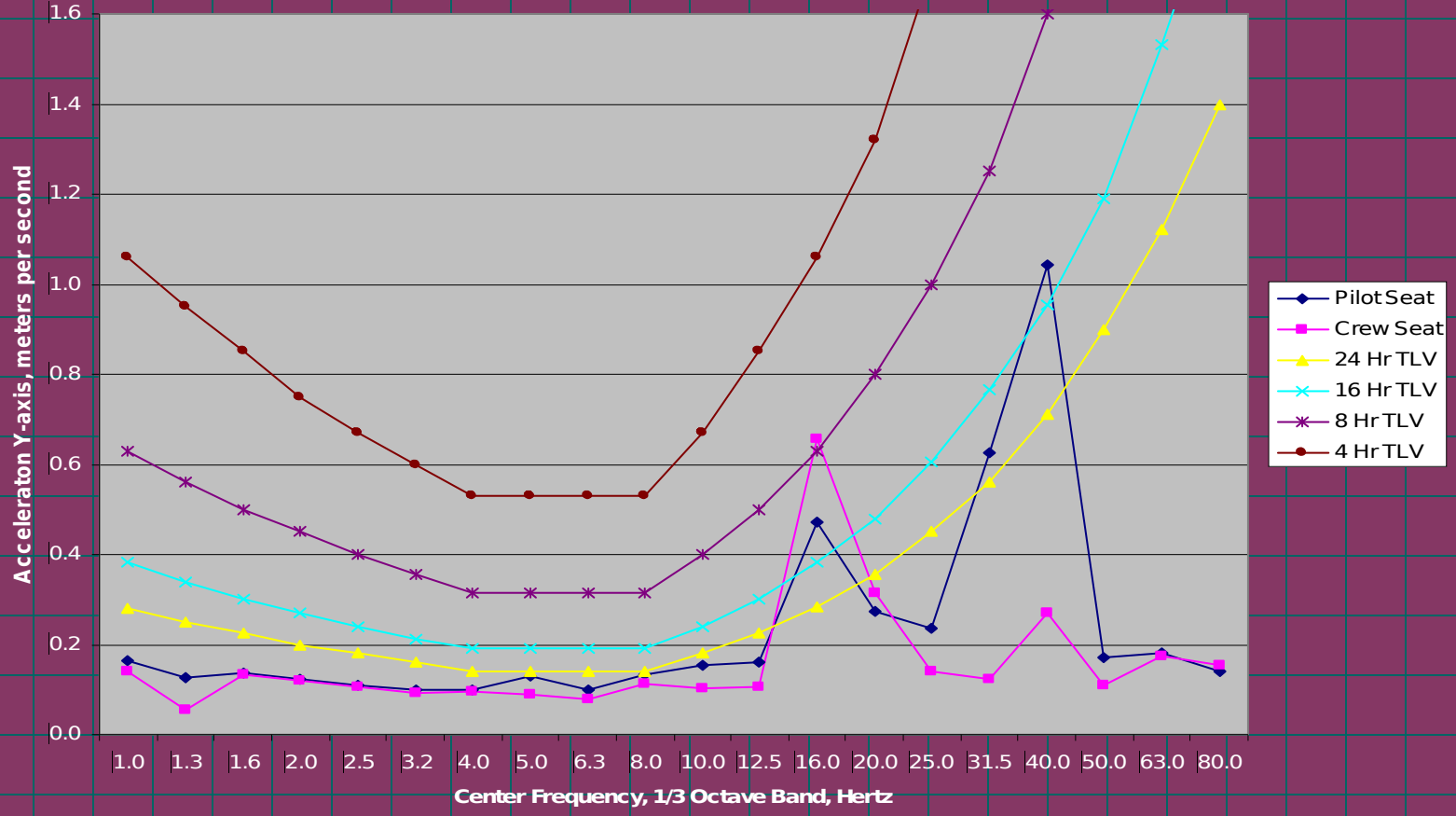
MH-60S X-Axis Mean Acceleration Values



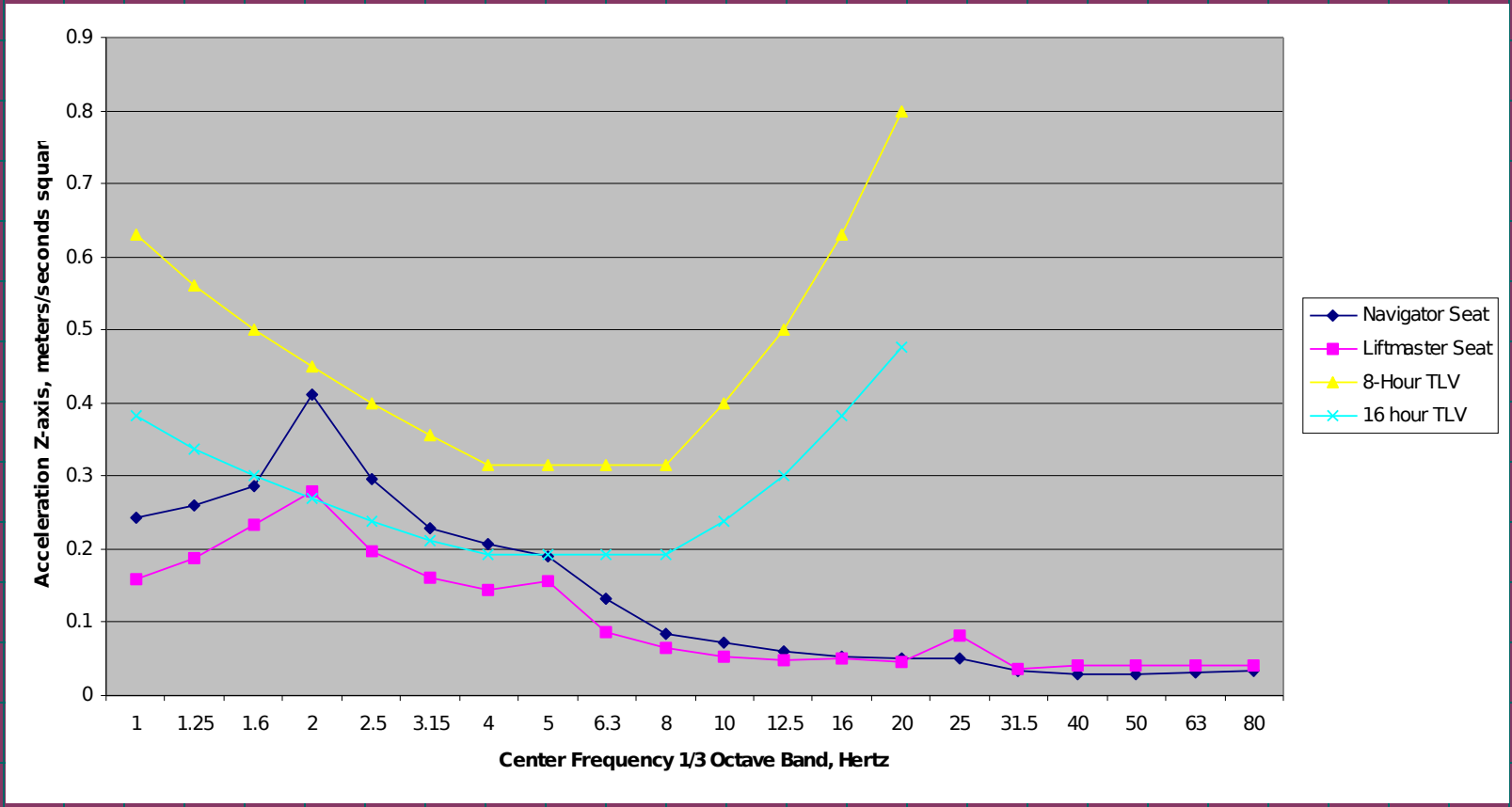
LCAC Y-axis Mean Acceleration Values



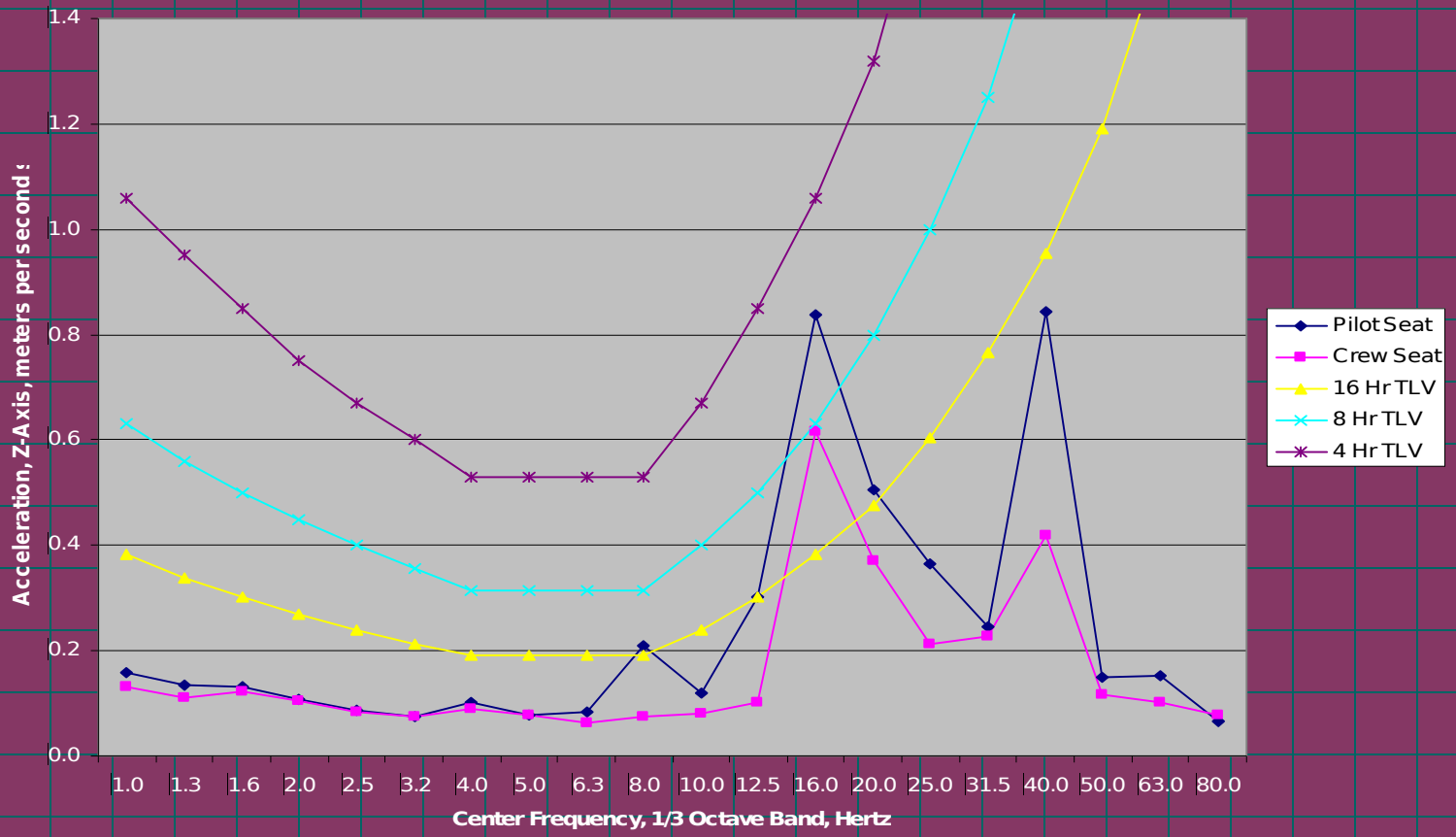
MH-60S Y-Axis Mean Acceleration Values



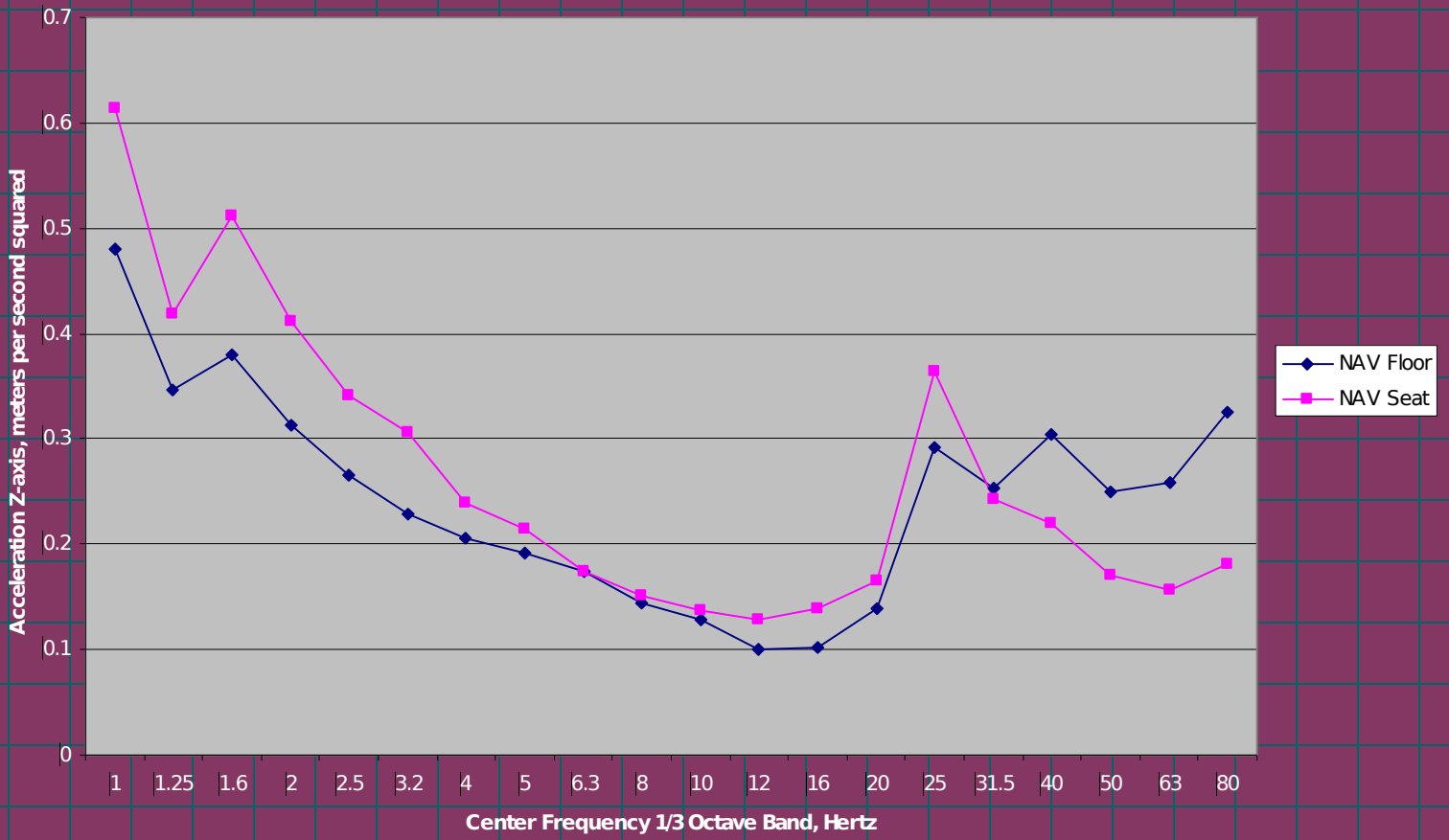
LCAC Z-axis Mean Acceleration Values



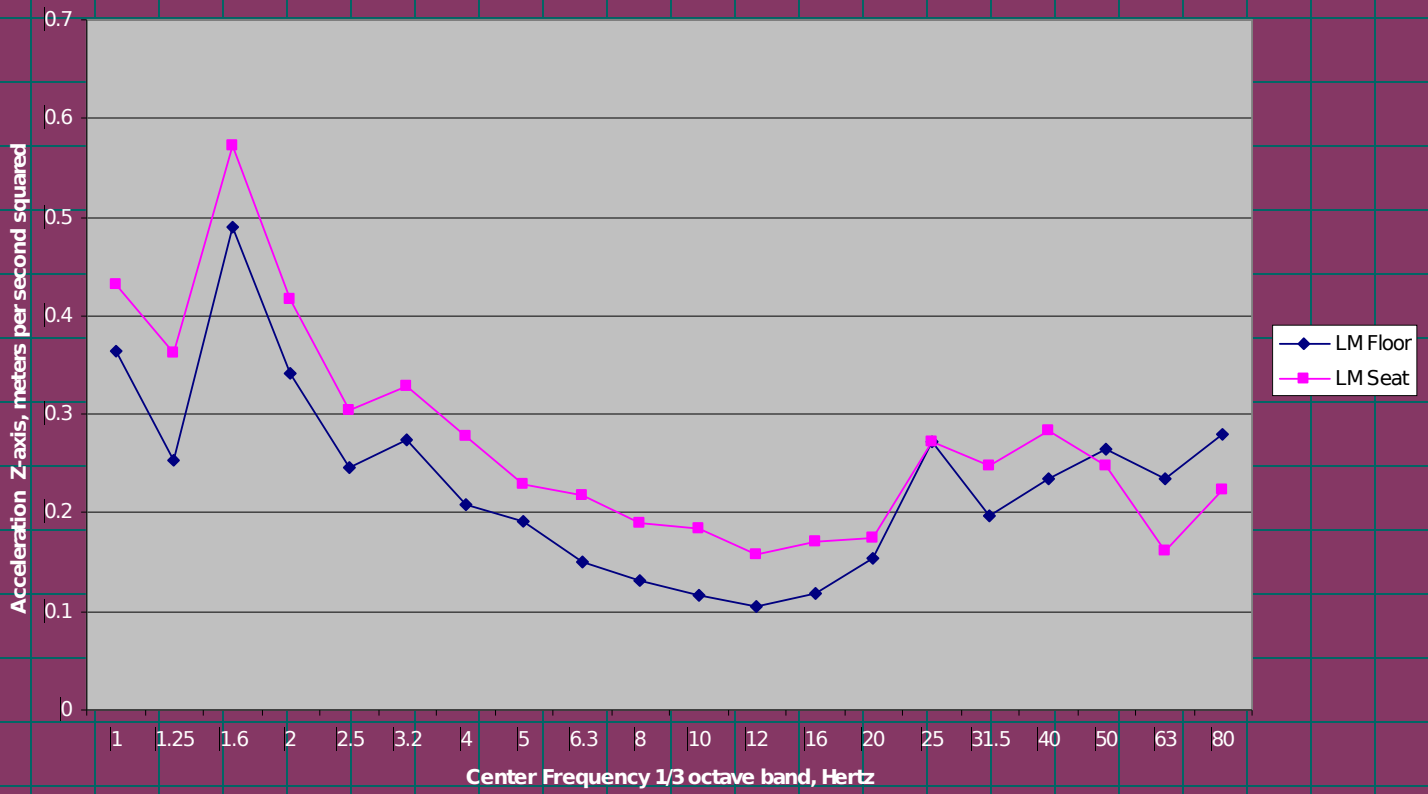
MH-60S Z-Axis Mean Acceleration Values



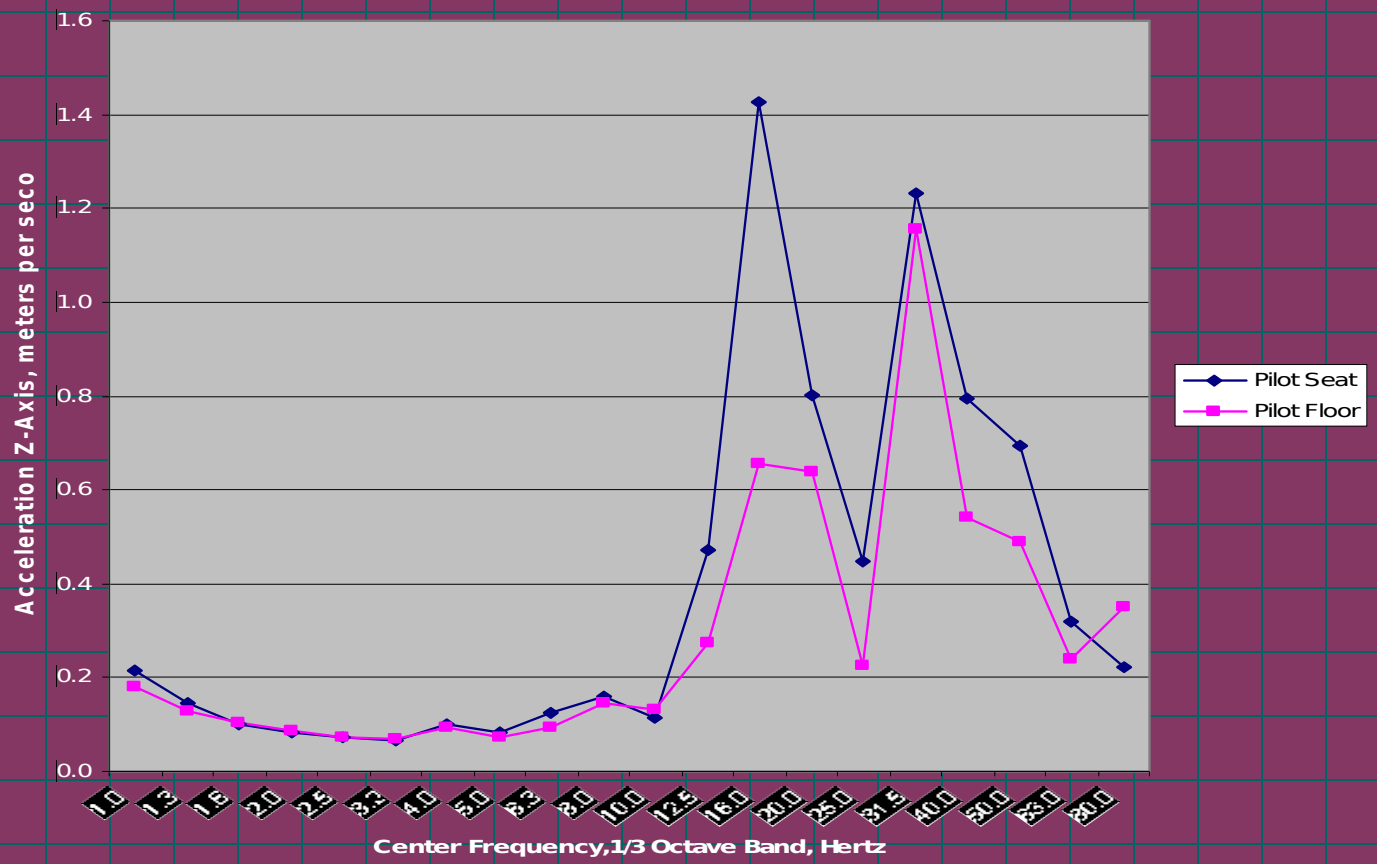
Transmissibility Study LCAC Navigation Seat



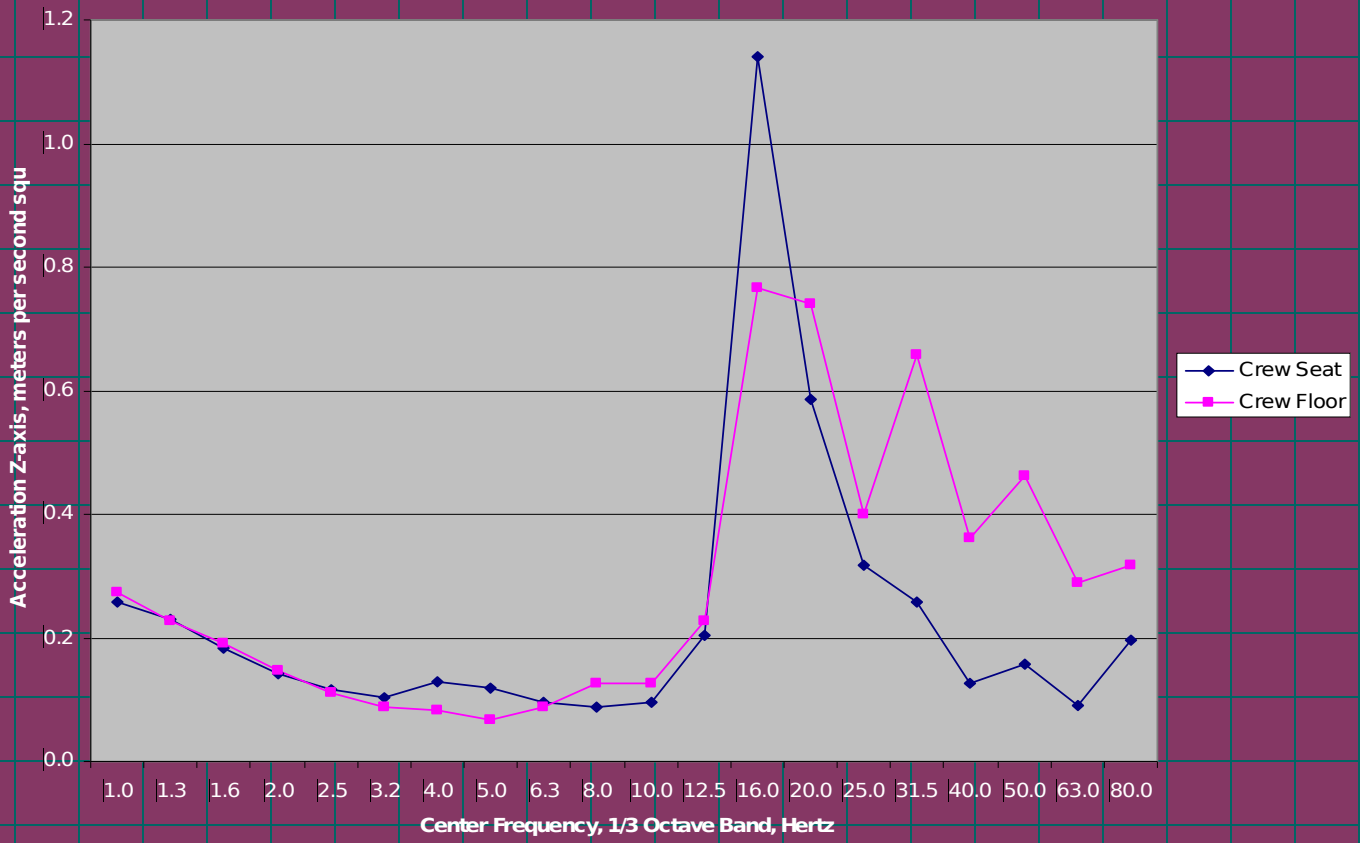
Transmissibility LCAC Study Liftmaster Seat



Transmissibility MH-60S Pilot Seat



Transmissibility MH-60S Crew Seat



Conclusions

- Navigation seat vs. Lift master seat (LCAC)
  - Lift master seat wins!
- Pilot seat vs. Crew seats (MH-60S)
  - Crew seat wins!

Conclusions

- For the LCAC the Z-axis is the worst.
  - 2 Hz is the dominant frequency
  - 16 hour TLV curve pierced
- For the MH-60S the X-axis was the worst.
  - 16 Hz is the dominant frequency
  - 4-8 hour TLV curves reached

Conclusions

- LCAC Transmissibility Data (@2 Hz)
  - Navigator seat 131%.
  - Lift master seat 121%
- MH-60S Transmissibility Data (@ 16 Hz)
  - Pilot seat 218 %
  - Crew seat 146%

Recommended Work Practices

- Administrative controls
- Limit routine and training operations to 8 hours maximum
- Redesign or engineering controls not necessary at this time
- Maintain seating systems and replace seats only when they become degraded

Questions?